2899

Compliance with Interim Status Requirements

for

Mercury Surface Impoundment at the Natrium, West Virginia, Plant of PPG Industries, Inc.

Support Information

January 12, 1983

ITEM 1

LOCATION OF MONITORING WELLS

Location and Physical Setting

The PPG plant at Natrium, West Virginia, lies along the Ohio River approximately thirty miles south of Wheeling and six miles north of New Martinsville. The plant takes up the northern half of an area known as Wells Bottom, a part of the Ohio River flood-plain that is five miles long and up to 0.4 mile wide (see Figure 1).

Wells Bottom is one of a series of alluvial features that fringe the Ohio River on alternate sides throughout its length. The bottom is composed of several recent river terraces cut into the flanks of an older and higher fluvio-glacial terrace.

The plant site rises in three steps from the river toward high-lands on the east. Elevation at the plant site varies from about 620 feet at the river level to about 700 feet at the base of the highlands. The terraces rise rather abruptly, but terrace tops are generally broad and flat. The high hills immediately east rise to an elevation of 1,300 feet within one mile.

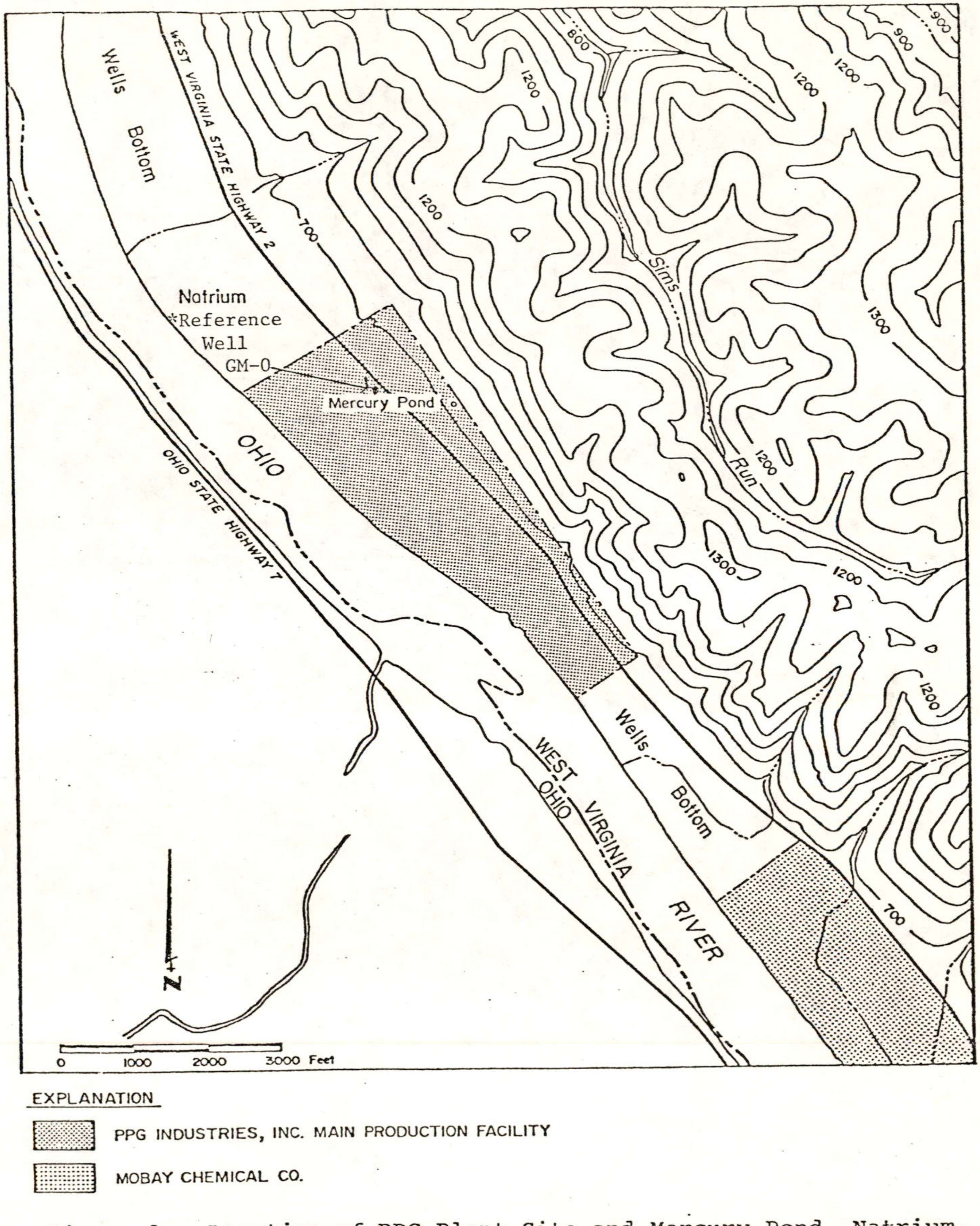
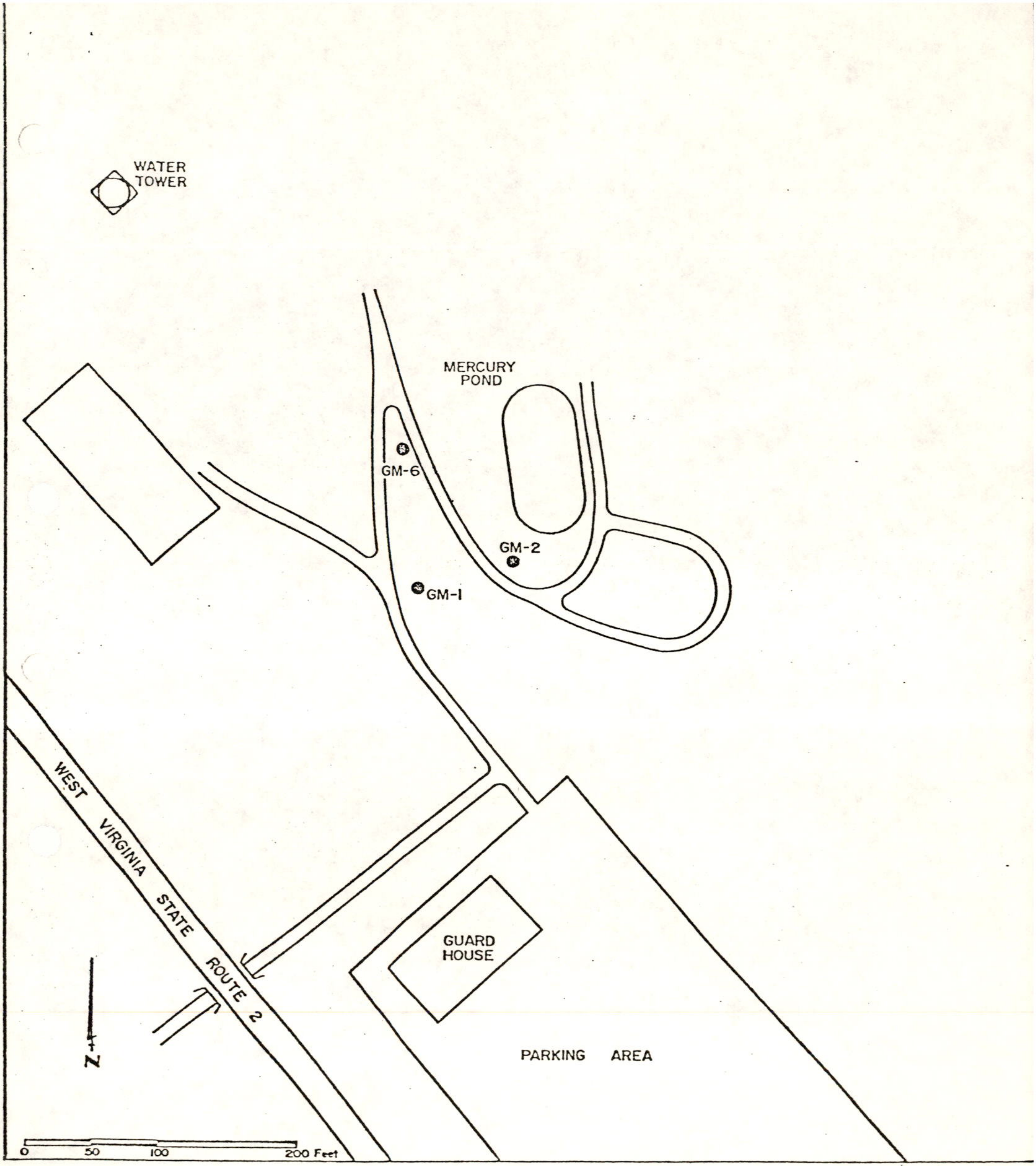


Figure 1. Location of PPG Plant Site and Mercury Pond, Natrium, West Virginia.

*The hydrogeological study performed prior to placement of the monitoring wells showed that there was no aquifer upgradient of this impoundment since it is located where the bedrock abruptly rises to a ridge above the impoundment. Since it was not possible to take an upgradient sample at the site, an existing well was chosen as the reference well (GM-0) to provide representative background groundwater quality in the uppermost aquifer of interest. The three downgradient wells are shown in more detail on following page.



EXPLANATION

GM-2 Monitor well and number

ITEM 2

GEOLOGIC, HYDROLOGIC, AND SOIL DATA

Geology

The Ohio River at Natrium is entrenched in Paleozoic sedimentary strata composed of sandstone, siltstone, clay, mudstone, marine limestone, fresh-water limestone, marly shale, and coal. Overlying this bedrock are Pleistocene alluvial deposits. The alluvium may be up to 120 feet thick beneath the higher Ohio River terraces and is composed of bedrock fragments of local origin and quartz, quartzite, granite, and chert which were transported south from continental glaciers. Along the edges of the valley, the river terraces may be capped by colluvial material (rock fragments) derived from bedrock highlands.

The soils along Wells Bottom at PPG are classified by the Soil Conservation Service as Made Land (includes filled and reworked material) and Brookside silt loam series. The area around the mercury pond is characterized by Brookside soils that are deep and well drained. This soil is underlain by colluvial material derived from limestone, acid sandstone, and alkaline and acid shale (SCS, 1960). Stone fragments are common throughout the profile.

Permeability of the Brookside series ranges from 5.6×10^{-4} cm/sec. (0.8 in./hr.) to 3.5×10^{-3} cm/sec. (5.0 in./hr.)(SCS, 1960). The subsoil is yellowish brown to grayish brown and ranges in acidity from strongly acid to slightly acid. The areas of less acid soil occur mostly at the base of steeper slopes.

Water Resources

Precipitation is ample and fairly well distributed throughout the year with maximum precipitation occurring during the summer and minimum in the fall (September to November). Total annual precipitation in the Ohio Valley increases from north to south. Normal precipitation for Wheeling is 38 inches and for New Martinsville, 44 inches. There is no available data concerning precipitation for Natrium, but it is assumed that average precipitation at the plant site is 40 to 42 inches per year.

The plant site lies along the Ohio River. River level is controlled at an elevation of approximately 623 feet by a dam to the south of the plant. The plant site naturally drains to the river via intermittent streams and overland flow. There is no channelized flow of surface water near the mercury pond except for drainage ditches along the pond access road.

Groundwater Conditions

Groundwater is found in several aquifers in the vicinity of PPG. The most important of these is the alluvial material of the Ohio River Valley. Yields from wells in these sediments typically are 100 to 500 gallons per minute (gpm). The Paleozoic bedrock generally is capable of producing only small quantities of water, and quality is usually poor.

Groundwater Conditions (Cont'd)

Water in the alluvium of the Ohio River Valley aquifer is of generally good quality with a total dissolved solids content of around 500 mg/l or less. The water may be locally hard and sulfurous.

Ohio River Alluvial Aquifer

The monitoring network installed at the mercury pond is designed to permit evaluation of the effect of the pond on groundwater quality by comparing water samples both hydraulically above and below the pond. Because of an abrupt change in elevation of the bedrock beneath the pond, however, an upgradient well did not intercept a water table in the alluvium. A well was located at a point presumed to be hydraulically upgradient, and wells GM-1, GM-2, and GM-6 were located hydraulically downgradient.

Site Hydrogeologic Conditions

The mercury pond is situated on a small and fairly level area which may be the remnant of an old river terrace. The terrace slopes very rapidly to the west below the pond and rises above the pond to the northeast to Wayne Ridge. Maximum relief of the site between GM-1 at the base of the terrace southwest of the pond to a point above and just northeast of the pond is 28.7 feet.

Surface drainage at the site is primarily via intermittent streams which arise east of the pond and flow to the northeast and southwest. These streams completely bypass the pond area. Several seeps of groundwater occur along the face of the terrace on which the mercury pond sits. The seeps are not sufficiently large to permit formation of channels.

Vertical Hydraulic Conductivities of Shelby Tube Sample

Well No.	Depth Interval (Ft.)	Hydraulic Conductivity (cm/sec.)	(ft./day)	Sample Description
GM-2	11-13	3.0×10^{-8}	8.5×10^{-5}	Clay, tight, plastic, brown and orange-tan, with weathered rock fragments, micaceous

Lithologic Characteristics

All bore holes constructed at the mercury pond encountered a heterogeneous mixture of clay, silt, sand, gravel, and weathered rock fragments overlying shaley mudstone or siltstone and sandstone bedrock. Depth to bedrock varied from approximately 50 to 100 feet, and changes in bedrock elevation range from 669 feet above the pond to less than 595 feet at GM-1.

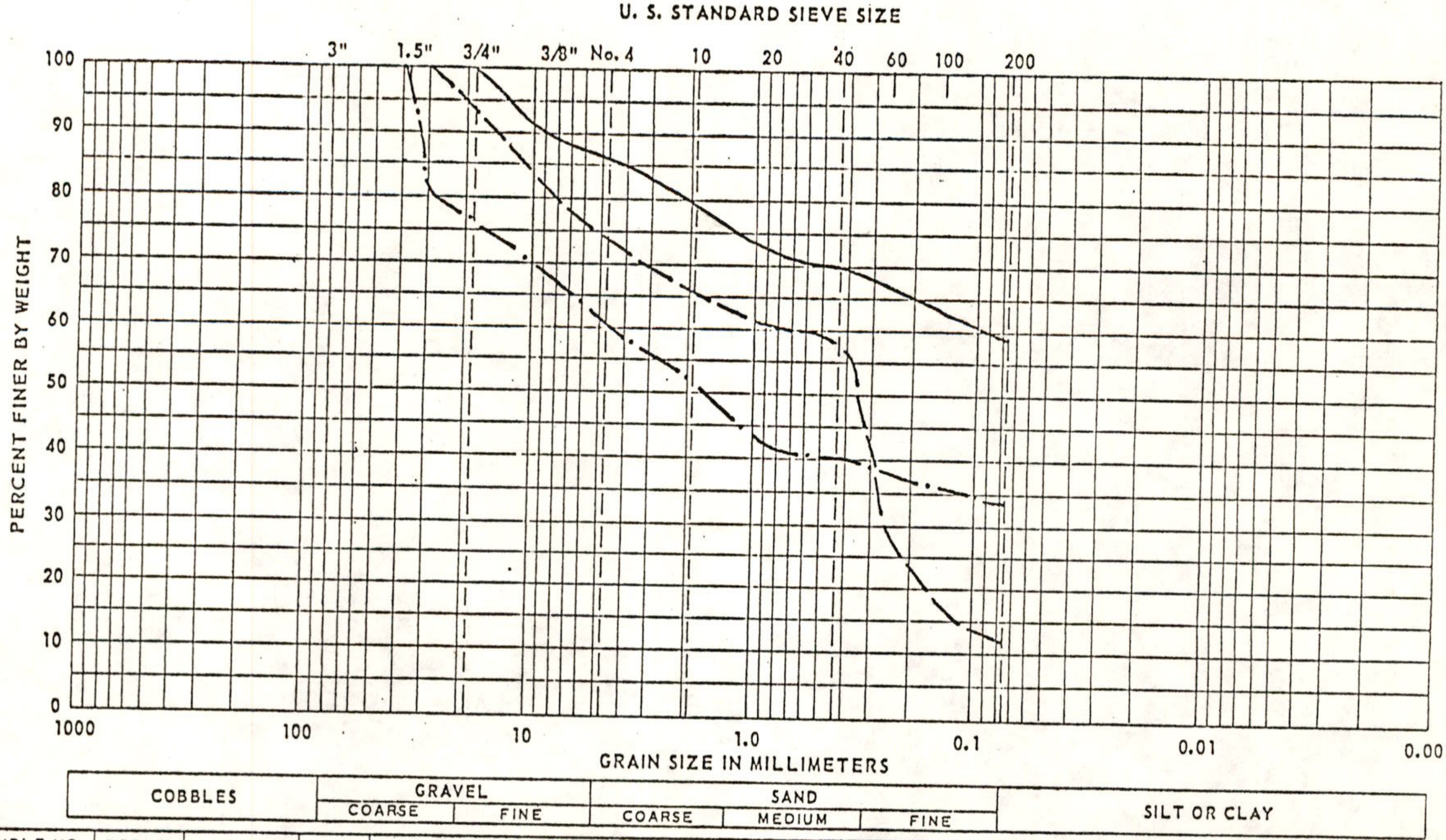
Lithologic Characteristics (Cont'd)

The diverse mixture of sediments encountered during drilling is representative of colluvial or detrital material deposited by landslides and slumping of material originating on the upland east of the pond site. Rock fragments are common throughout the sedimentary sequence.

Cation Exchange Capacities of Selected Lithologic Samples

Well No.	Depth Interval (Ft.)	Cation Exchange Capacity (meq/100 gm)	Sample Description
GM-2	13 - 14.5	5.04	Clay, tight, plastic, brown and orange tan; with weathered rock fragments
GM-2	59.5 - 61	9.62	Clay, tight, plastic, red-brown; with weathered sandstone rock fragments
GM-2	99.5 - 101	10.39	Clay, brown, wet with rock fragments; mud-stone bedrock in lower half of sample

GRAIN SIZE DISTRIBUTION CURVE



SAMPLE NO.	BORING	DEPTH	LINE	CLASSIFICATION	NAT. WC	LL	PL	PI	REMARKS	PLOTTED BY:
TUBE	B-2	11.0'-13.0'	——	DK BRN MED STIFF CLAYEY SILT SOME SAND LITTLE GRAVEL	14%				LITTLE F, M, C SANDS } SUB; FEW F, M GRAVELS } ANGULAR	NR
S-10	B-2	34.5'-36.0'	— —	TAN BRN LOOSE SILTY SAND, SOME GRAVEL	7%				LITTLE FINES SOME F, M, GRAVELS-SUBANGULAR	NR
S-24	B-2	104'-105.5'	—·—	GRAY MED STIFF SILTY CLAY AND GRAVEL SOME SAND	7%				WELL GRADED SUBANGULAR SANDS AND GRAVELS	NR
			—··—							

GERAGHTY & MILLER INC.
PPG INDUSTRIES NATRIUM, W. VA.

PITTSBURGH TESTING LABORATORY

ORDER NO. BLT 317

FORM NO. 1135

GM-1

Elevation - top of outer casing:693.10 ft, msl

Lithologic Description	Depth (ft)	Thickness (ft)
Sandy loam, red brown	0 - 2	2
Clay, cinders, coal, sandstone fragments, red brown, moist	2 - 13	11
Gravel, poorly sorted, clayey, red brown, very moist	13 - 18	5
Clay, gravelly, coal fragments, red brown	18 - 23	5
Sand, medium to coarse grained, well sorted, red brown, coal fragments	23 - 43	20
Clay, stiff, red brown to yellow brown, weathered green to gray sandstone fragments	43 - 68	25
Silt, clayey, gray to yellow brown, iron stains	68 - 73	5
Clay, massive, plastic, gray	73 - 83	10
Silt, sandy, gray green to brown, sandstone fragments	83 - 93	10
Sand, silty, fine-grained, subrounded yellow brown, brownish-green gravel	93 - 96	3

GM-2

Elevation - top of outer casing: 709.88 ft, msl

Lithologic Description	Depth (ft)	Thickness (ft)
Silt, loam, brown, gravel	0 - 3	3
Clay, silty, brown to yellow brown, sandstone fragments, moist	3 - 33	30
Sand, medium grained, white to orange brown, rock fragments	33 - 43	10
Silt, clayey, tan to gray, wet	43 - 48	5
Clay, plastic, silty, red brown, weathered sandstone and coal fragments	48 - 93	45
Clay, gray to brown, coal and sandstone fragments, sand and silt lenses, moist	93 - 100	7
Mudstone, weathered, friable, gray, dry	100 - 106	6

Elevation - top of outer casing: 696.90 ft, msl

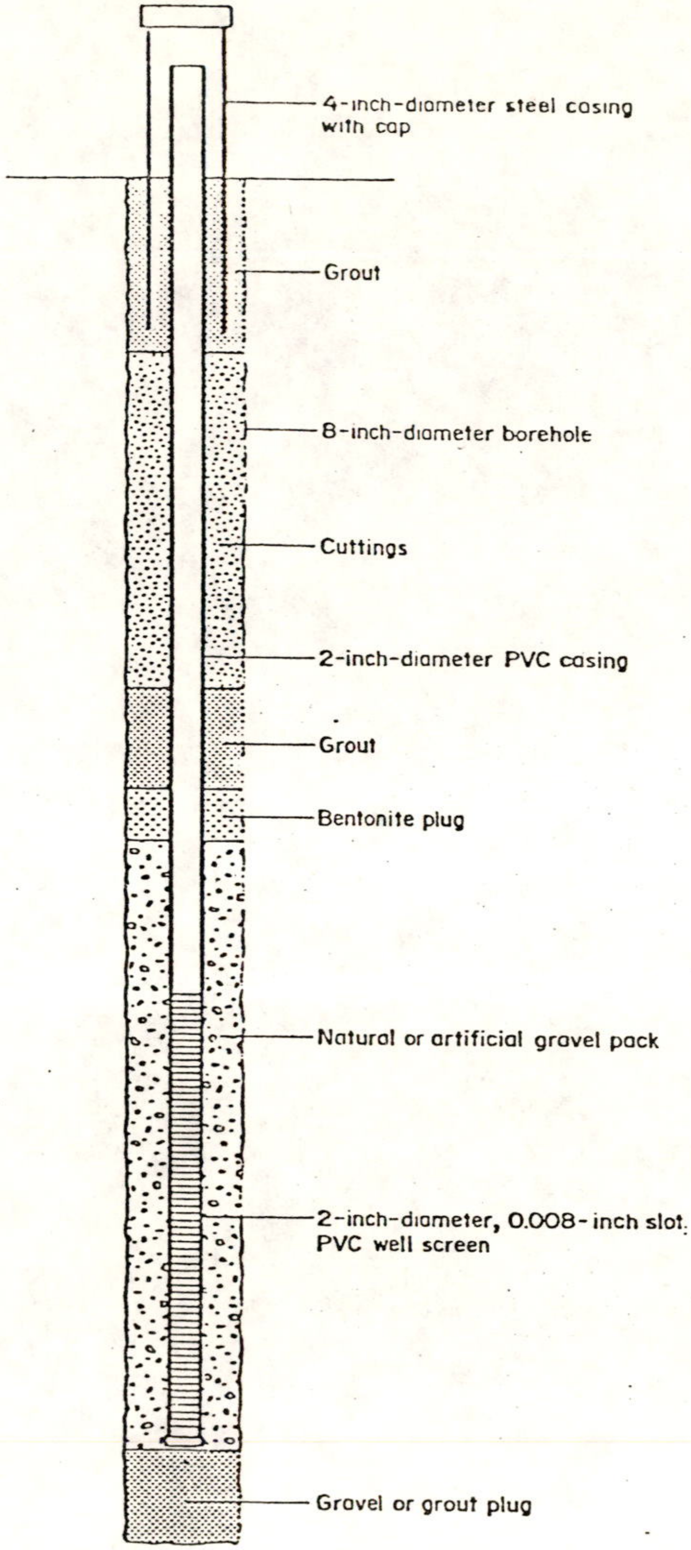
Lithologic Description	Depth (ft)	Thickness (ft)
Clay loam, orange brown, gravel, moist	0 - 3	3
Clay, dense, brown, gravelly	3 - 18	15
Sand, silty, medium to coarse grained, poorly sorted, brown, moist, sandstone fragments	18 - 41	23
Clay, dense, red brown, sandstone fragments	41 - 60	19
Silt, clayey, green, wet	61 - 64	3
Clay, stiff, red brown, sandstone fragments	64 - 75	11
Siltstone, friable, gray, micaceous, shaley	75 - 80	5

ITEM 3

MONITORING WELL CONSTRUCTION DATA

Pittsburgh Testing Laboratories, using a CMEB-61 drill rig, installed bore holes to depths ranging between 45 to 100 feet. A 3-3/8 inch inside diameter hollow-stem auger was utilized to drill through the unconsolidated material above bedrock. A 2-inch outside diameter split-spoon sampler was driven ahead of the auger bit to collect soil samples. These samples were visually identified and are described in more detail in the Lithologic Characteristics section.

Monitor wells were installed in the bore holes using a 2-inch diameter PVC casing and 0.008 inch slot PVC well screen. Gravel was placed in the annulus between the screen and bore hole to at least 5 feet above the top of the screen. A bentonite plug was placed on top of the gravel, and a combination of Type I Portland cement and cuttings was used to seal the annular space to land surface. A 4-inch steel protective casing was installed around the PVC casing above land surface. A diagram of the well construction is shown in attached Figure 2.



Well Number	Elevation* (ft)	Total Depth* (ft)
GM-1	693.10	99
GM-2	709.88	102
GM-6	696.90	78

* Measurement from top of outer casing.

FIGURE 2: ELEVATION AND DEPTH OF MONITOR WELLS

ITEM 4

SAMPLING AND ANALYSIS PLAN

EVALUATION OF GROUND-WATER QUALITY IMPACTS AT THE PPG MERCURY POND, NATRIUM, WEST VIRGINIA

Final Report

Prepared For:

PPG INDUSTRIES
Natrium, West Virginia

By:

GERAGHTY & MILLER, INC.
Annapolis, Maryland

April, 1981

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FIGURES

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INTRODUCTION

In September 1980, Geraghty & Miller, Inc., was retained by PPG Industries, Inc. (PPG) to assess the impact of a mercury pond at the Natrium, West Virginia, plant on ground-water quality and to develop a monitoring program to comply with federal hazardous-waste regulations. To meet the study objectives, an exploratory drilling program was undertaken at the mercury pond to collect data on geology, depth and location of ground water, direction of ground-water movement, and ground-water quality. Available published and unpublished data on regional geology and hydrology were collected for evaluation.

Contained within this report are the findings of the hydrogeologic study made at the mercury pond. Also included are recommendations for ground-water monitoring to be carried out by PPG in compliance with hazardous-waste regulations promulgated by the U.S. Environmental Protection Agency.

Operational History

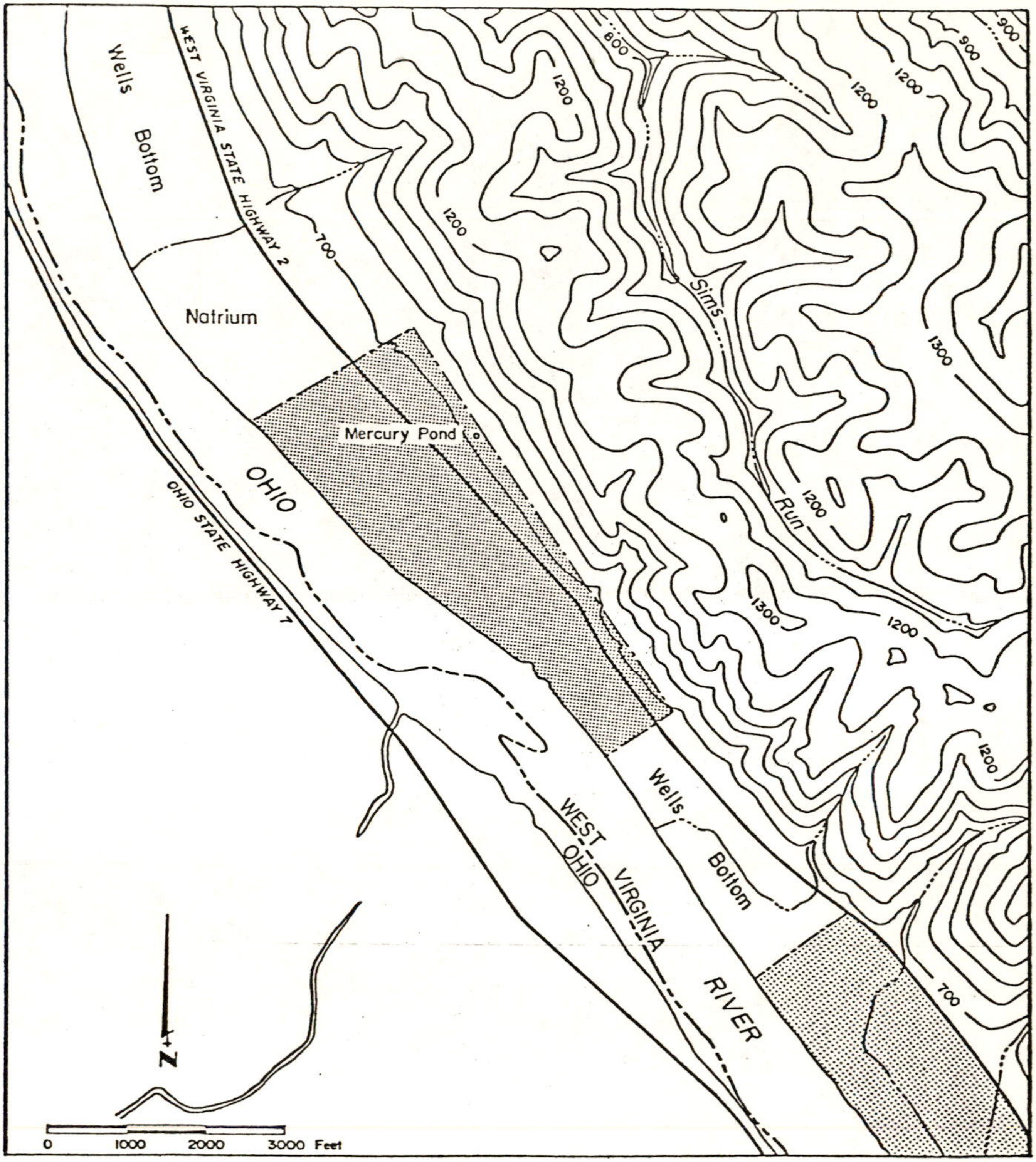
The PPG plant at Natrium makes a wide variety of predominantly inorganic compounds. Chlorine used by the plant is produced on the plant property through a solution mining operation of sodium chloride.

For several years, the facility that is now the mercury pond was used as a storage basin for sodium chloride brine produced from wells. The facility was concrete lined and used until about 1960. In the early 1970's, PPG equipped the basin with a plastic liner to handle waste flow from the plant's mercury cell, chlorine circuit. The mixed mercury waste entering the pond is precipitated as mercury sulfide and the resultant clarified liquid effluent is treated via carbon filtration prior to discharge in the Ohio River. The pond is periodically cleaned of mercury sulfide and the liner has been replaced once.

Location and Physical Setting

The PPG plant at Natrium, West Virginia, lies along the Ohio River approximately 30 miles (mi) south of Wheeling and 6 mi north of New Martinsville. The plant takes up the northern half of an area known as Wells Bottom, a part of the Ohio River floodplain that is 5 mi long and up to 0.4 mi wide (see Figure 1).

Wells Bottom is one of a series of alluvial features that fringe the Ohio River on alternate sides throughout its length. The bottom is composed of several recent river terraces cut into the flanks of an older and higher fluvio-glacial terrace.



EXPLANATION

PPG INDUSTRIES, INC. MAIN PRODUCTION FACILITY

MOBAY CHEMICAL CO.

Figure 1. Location of PPG Plant Site and Mercury Pond, Natrium, West Virginia.

The plant site rises in three steps from the river toward highlands on the east. Elevation at the plant site varies from about 620 feet (ft) at the river level to about 700 ft at the base of the highlands. The terraces rise rather abruptly but terrace tops are generally broad and flat. The high hills immediately east rise to an elevation of 1,300 ft within one mile.

REGIONAL SETTING

Geology

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The soils along Wells Bottom at PPG are classified by the Soil Conservation Service as Made Land (includes filled and reworked material) and Brookside silt loam series. The area around the mercury pond is characterized by Brookside soils that are deep and well drained. This soil is underlain by colluvial material derived from limestone, acid sandstone, and alkaline and acid shale (SCS, 1960). Stone fragments are common throughout the profile.

Permeability of the Brookside series ranges from 5.6×10^{-4} cm/sec (0.8 in/hr) to 3.5×10^{-3} cm/sec (5.0 in/hr)(SCS, 1960). The subsoil is yellowish brown to grayish brown and ranges in acidity from strongly acid to slightly acid. The areas of less acid soil occur mostly at the base of steeper slopes.

Water Resources

Precipitation is ample and fairly well distributed throughout the year with maximum precipitation occurring during the summer and minimum in the fall (September to November). Total annual precipitation in the Ohio Valley increases from north to south. Normal precipitation for Wheeling is 38 inches (in) and for New Martinsville, 44 in. There is no available data concerning precipitation for Natrium, but it is assumed that average precipitation at the plant site is 40 to 42 in per year.

The plant site lies along the Ohio River. River level is controlled at an elevation of approximately 623 ft by a dam to the south of the plant. The plant site naturally drains to the river via intermittent streams and overland flow. There is no channelized flow of surface water near the mercury pond except for drainage ditches along the pond access road. Table 1 gives a summary of Ohio River water-quality at Newell and Ravenswood, West Virginia, and for Fishing Creek at New Martinsville.

Ground-Water Conditions

Ground water is found in several aquifers in the vicinity of PPG. The most important of these is the alluvial material of the Ohio River valley. Yields from wells in these sediments typically are 100 to 500 gallons per minute (gpm). The Paleozoic bedrock generally is capable of producing only small quantities of water, and quality is usually poor.

Water in the alluvium of the Ohio River valley aquifer is of generally good quality with a total dissolved solids content of around 500 mg/l or less. The water may be locally hard and sulfurous. PPG is presently pumping about 5,000 gpm from wells constructed into the alluvium.

TABLE 5. QUALITY OF SURFACE WATER IN THE OHIO RIVER VALLEY NEAR NATRIUM, WEST VIRGINIA (All analyses are expressed in mg/l, except pH and specific conductance, which are expressed in standard units).

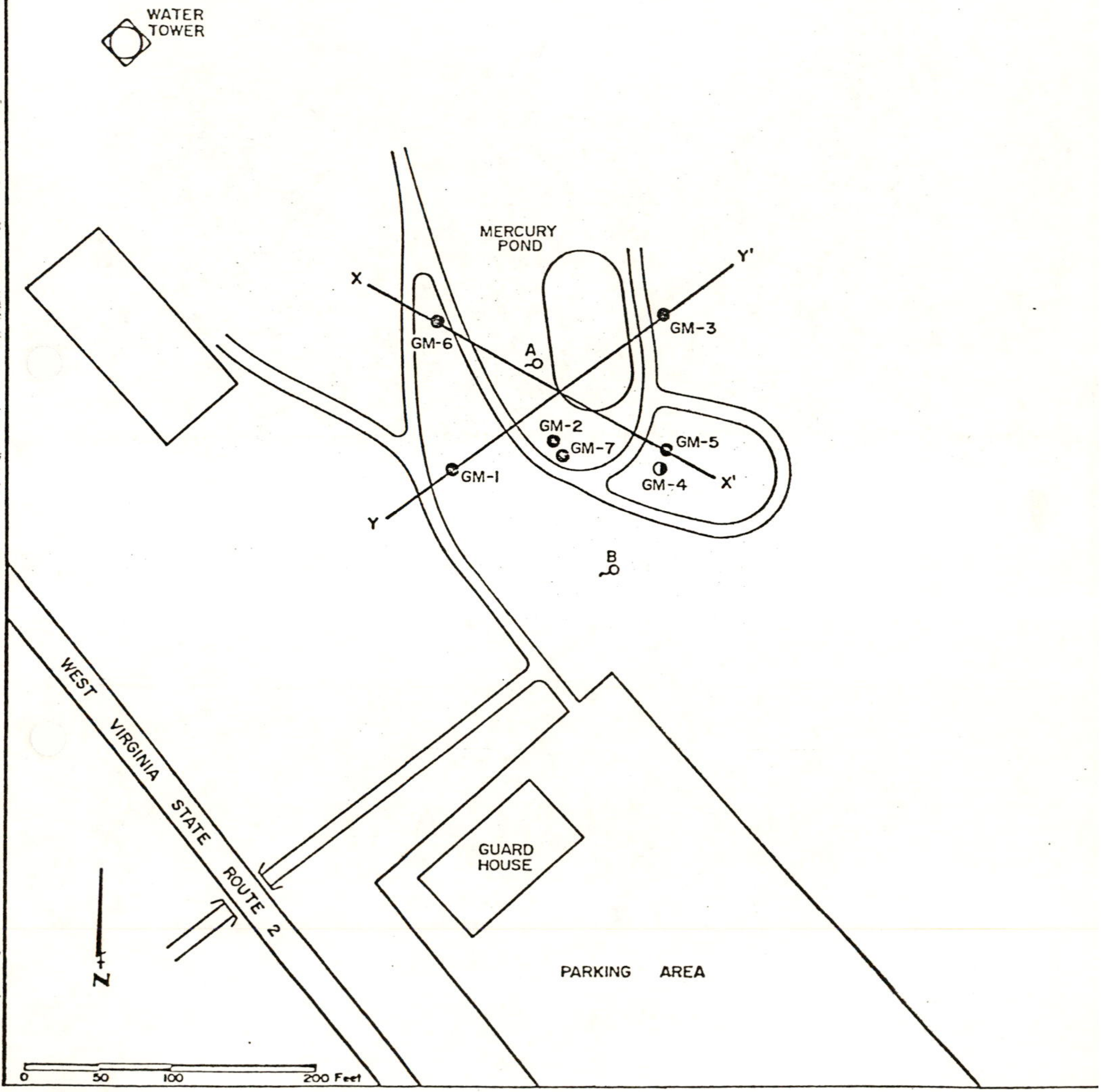
PARAMETER	Ohio River at Newell, WVa. (1960 mean)	Ohio River at Ravenwood, WVa. (1960 mean)	Fishing Creek at New Martinsville, WV (10/1/60)
Specific Conductance	360	413	304
Total Dissolved Solids	226	255	164
pH	-	-	7.4
Calcium	32	39	26
Sodium	19	24	21
Magnesium	9.2	9.6	6.1
Potassium	2.2	2.3	2.2
Total Iron	-	-	0.3
Manganese	-	-	0.28
Chloride	15	31	40
Bicarbonate	14	36	75
Sulfate	122	111	23
Nitrate	3.9	3.9	0.2
Fluoride	0.3	0.3	0.2
Silica	7.4	6.9	3.1
Total Hardness as $CaCO_3$	225	245	118

SITE INVESTIGATION

Soil Borings and Monitor-Well Installation

The field data-collection program was conducted during October and early November 1980. Pittsburgh Testing Laboratory, using a CME B-61 drill rig, installed boreholes to depths ranging between 45 to 100 ft at the locations shown on Figure 2. A 3-3/8-in inside diameter hollow-stem auger was used to drill through the unconsolidated material above bedrock. A 2-in outside diameter split-spoon sampler was driven ahead of the auger bit to collect soil samples. Split-spoon samples were taken at 5-ft intervals in holes GM-1, GM-2, GM-3, and GM-6. In GM-4, split-spoon samples were collected continuously from land surface to approximately 46 ft and at 5-ft intervals thereafter to 80 ft. Due to proximity to other boreholes, a limited sampling program was undertaken at GM-5 and GM-7. A 3-in outside diameter thin-walled Shelby tube sampler was used to collect undisturbed soil samples at 5 to 9 ft in GM-7, at 11 to 13 ft in GM-2, and at 27 to 29 ft in GM-3.

Samples collected using the split-spoon sampler were visually identified and logged in the field (see Appendix A for lithologic logs of all boreholes). Selected samples were analyzed in the laboratory for grain-size distribution (see Appendix B). The Shelby tube samples collected in GM-2



EXPLANATION

GM-3	Monitor well and number	A	Ground-water seep
GM-4	Borehole and number	X—X'	Line of geologic cross section

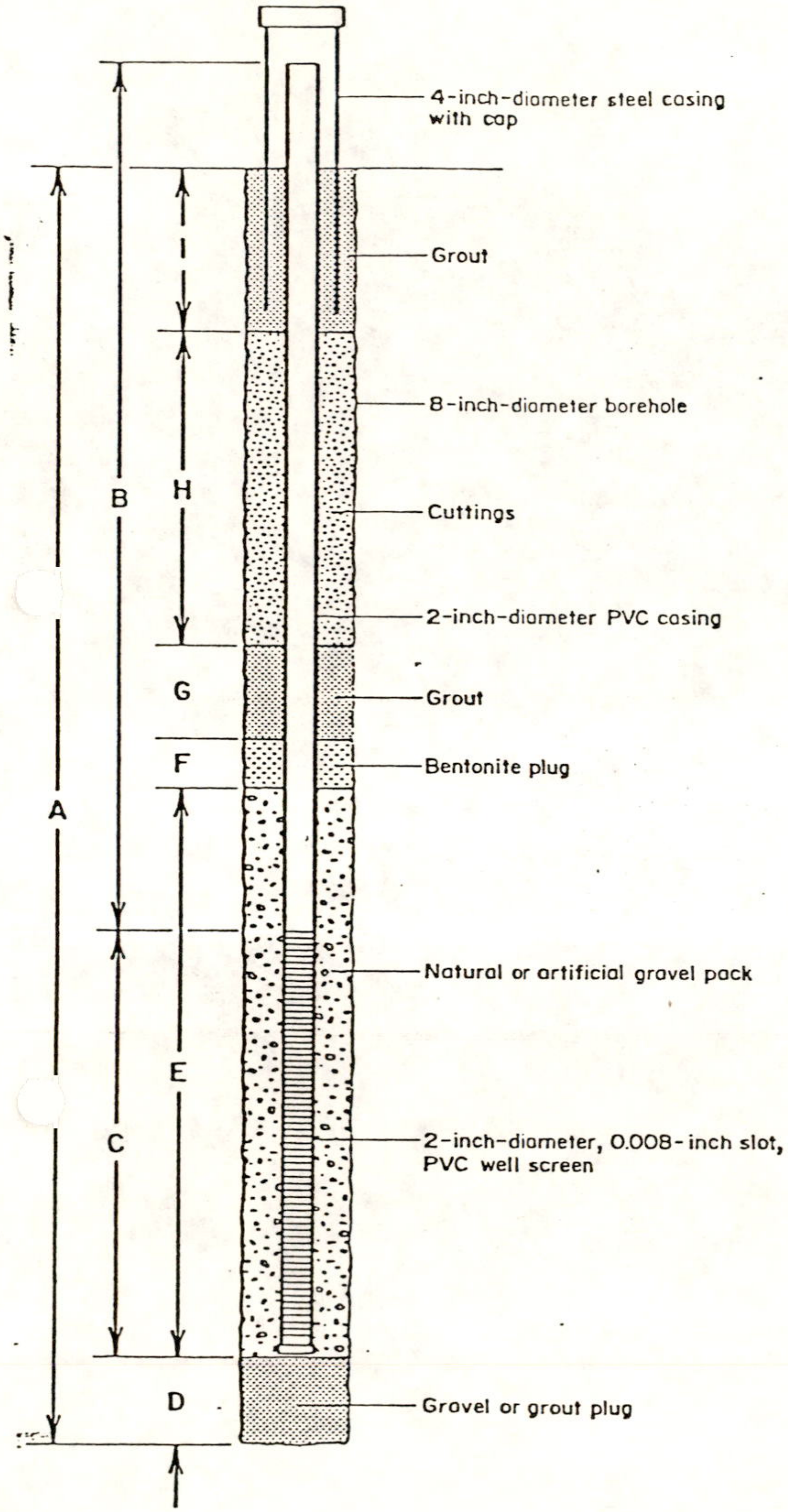
Figure 2. Location of Monitor Wells, Soil Borings, Seeps, and Geologic Cross Sections at PPG, Natrium, West Virginia.

and GM-3 were tested in the laboratory to determine hydraulic conductivity, and those collected in GM-7 were used to prepare water extracts for the purpose of water-quality analyses.

Monitor wells were installed in all boreholes (except GM-4) using 2-in-diameter PVC casing and 0.008-in slot PVC well screen. Gravel was placed in the annulus between the screen and borehole to at least 5 ft above the top of the screen. A bentonite plug was placed on top of the gravel and a combination of Type I Portland cement and cuttings were used to seal the annular space to land surface. A 4-in steel protective casing was installed around the PVC casing above land surface. A diagram of the well construction is found in Figure 3.

Water-Quality Sampling

Following development of each monitor well to remove sediment, water samples were collected for the purpose of analysis to determine quality. Using a PVC bailer, samples were withdrawn from wells GM-1, GM-2, and GM-6. In addition, water samples were collected from the mercury pond prior to release to the carbon beds, and from one of the PPG water-supply wells. There was insufficient water in wells GM-3, GM-5, and GM-7 to permit sampling. The samples were analyzed for selected parameters by the PPG laboratory.



DIMENSION, IN FEET	GM-1	GM-2	GM-3	GM-5	GM-6	GM-7
	WELL NUMBER					
A	96	99.75	54.75	45	81	54
B	89	92	23.25	37.3	67.9	47.3
C	10	10	10	10	10	10
D	0.6	1.0	24.75	1.0	6.2	0
E	32.4	31.25	15	14.25	21.8	27
F	1	1	1	1	1	1
G	10	16.5	5	9.75	12.5	9
H	48	47	7	16.5	37.5	15
I	4	3	2	2.5	2	2

Figure 3. Monitor-Well Construction Diagram.

Water samples were also collected from two seeps located below the mercury pond. Only a limited set of analyses were made on these samples.

During drilling several highly moist zones were encountered. At many locations, there was insufficient water to permit extraction via wells. In order to determine water quality in these areas, the Shelby tube sampler was used to collect soil samples that were later subjected to leaching with distilled water to allow an approximation of the quality of water in this zone. Two Shelby tube samples were collected in boring GM-7 and leached by the PPG laboratory.

SITE HYDROGEOLOGIC CONDITIONS

Topography and Drainage

The mercury pond is situated on a small and fairly level area which may be the remnant of an old river terrace. The terrace slopes very rapidly to the west below the pond and rises above the pond to the northeast to Wayne Ridge. Maximum relief of the site between GM-1 at the base of the terrace southwest of the pond to GM-3 located just northeast of the pond is 28.7 ft.

Surface drainage at the site is primarily via intermittent streams which arise east of the pond and flow to the northeast and southwest (see Figure 1). These streams completely by-pass the pond area. Several seeps of ground water occur along the face of the terrace on which the mercury pond sits. The seeps are not sufficiently large to permit formation of channels.

Lithologic Characteristics

All seven boreholes constructed at the mercury pond encountered a heterogeneous mixture of clay, silt, sand, gravel, and weathered rock fragments overlying shaley mudstone or siltstone and sandstone bedrock. Depth to bedrock varied from approximately 50 to 100 ft and changes in bedrock elevation range from 669 ft at GM-3 to less than 595 ft at GM-1.

The diverse mixture of sediments encountered during drilling is representative of colluvial or detrital material deposited by landslides and slumping of material originating on the upland east of the pond site. Rock fragments are common throughout the sedimentary sequence.

Figures 4 and 5 present two geologic cross sections of the site as determined from boring logs. As shown in the cross sections, there is a great deal of clay present beneath the pond site. The clay layers appear to be continuous rather than lenses and range from 8 to 28 ft in thickness. Weathered rock fragments and minor amounts of gravel and

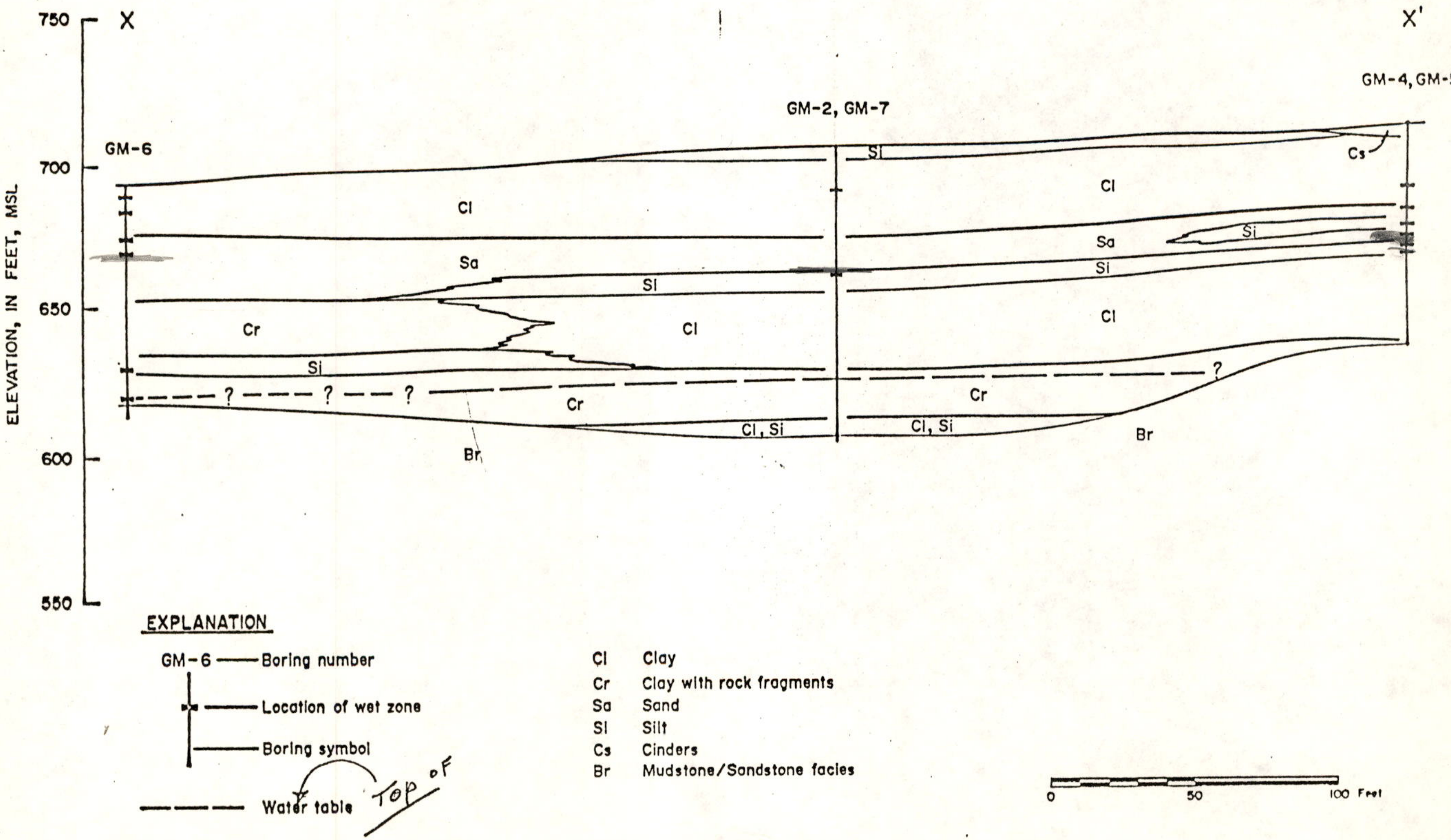


Figure 4. Geologic Cross Section (X-X'), PPG, Natrium, West Virginia.

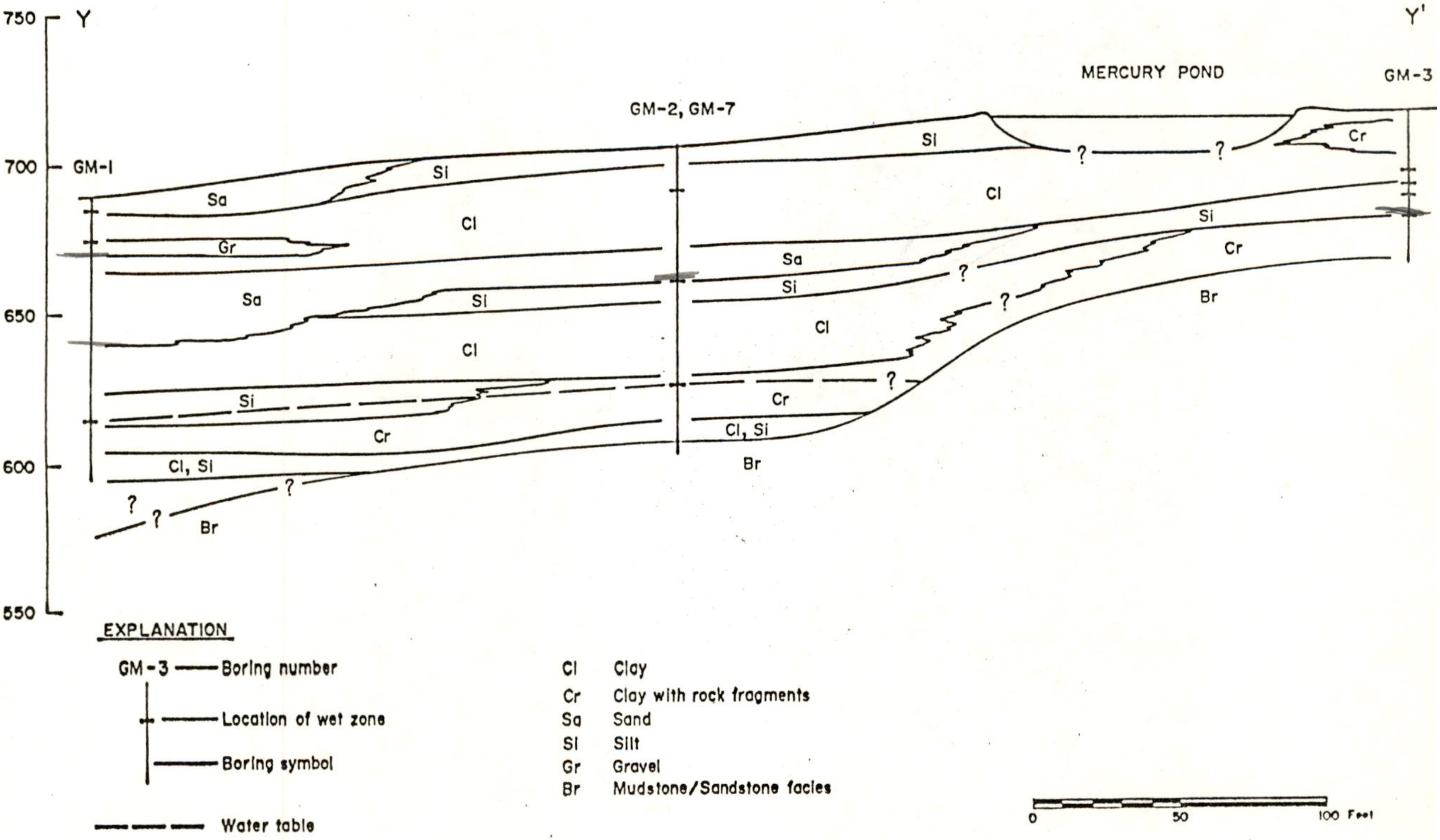


Figure 5. Geologic Cross Section (Y-Y'), PPG, Natrium, West Virginia.

silt or sand are found throughout the clay layers.

A clean, generally well sorted and dry brown sand found at most locations beneath the upper clay, generally at 20 to 30 ft below land surface, ranges from 10 to 25 ft in thickness. This unit, although occasionally moist, was never found to be thoroughly saturated with water. Underlying the sand layer is a moist to wet silt unit, 4 to 12 ft in thickness. A thick clay layer is then found above a silt unit which rests on a weathered bedrock surface. The bedrock surface rises rapidly beneath the mercury pond. The bedrock, which is composed of mudstone or fine-grained sandstone, is highly weathered at the interface.

Ground-Water Flow

Two zones of ground water were encountered during drilling around the mercury pond: (1) a discontinuous perched water table and (2) the deeper Ohio River valley alluvial aquifer. Perched-water conditions were encountered at various depths to about 30 ft below land surface in small silt and sand layers (Table 2). These wet zones were present in all boreholes but during the fall of 1980 there was not sufficient water to be collected in the shallow wells. The perched water table may yield water to wells during spring and early summer in response to increased recharge of precipitation in the fall and winter months. (Monitor wells

TABLE 2. ELEVATION AND LITHOLOGIC DESCRIPTION OF PERCHED WATER ZONES

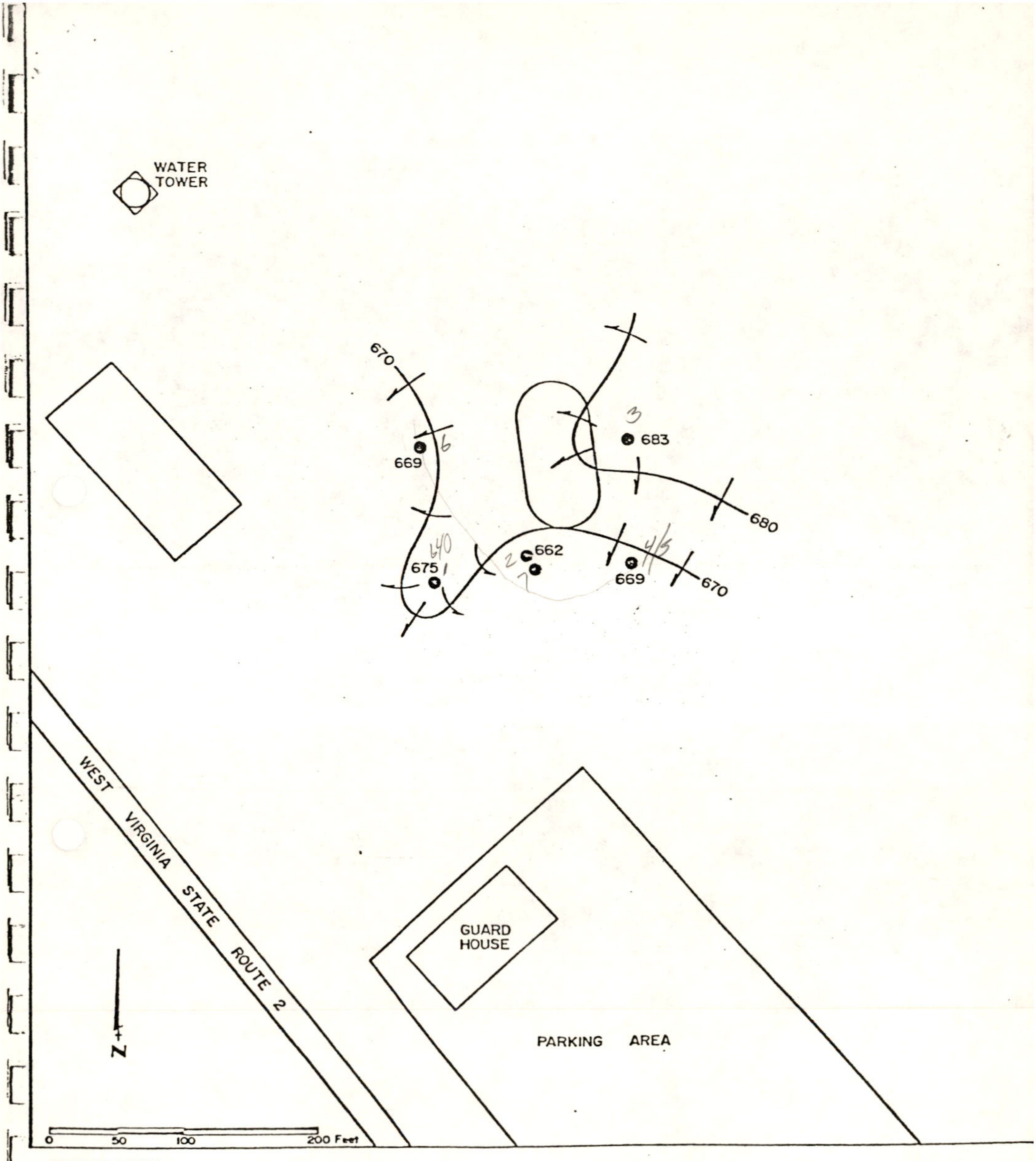
Well Number	Elevation of Perched Water Zones (ft)	Generalized Description
GM1	685	Sand/clay interface
	675	Clay/gravel interface
GM2	692	Clay
	662	Sand/silt interface
GM3	698	Clay
	694	Silt
	690	Silt
	683	Silt/clay and rock fragments interface
GM4/5	694	Clay and gravel
	685	Sand
	680	Silt
	676	Sand
	672	Silt
	669	Silt
GM6	689	Clay
	684	Clay
	674	Sand
	669	Sand

were installed at GM-3, GM-5, and GM-7 to monitor the perched water table.) Several seeps along the face of the terrace below the mercury pond discharge from the perched water zone. Figure 6 shows the elevation of the lowermost perched conditions found in boreholes and maps an inferred flow system. Ground-water flow in this zone is to the west and toward the Ohio River.

Approximately 50 ft beneath the perched water table is the semi-confined Ohio River valley alluvial aquifer. The aquifer is found in silt and fine sand at the bedrock interface. The aquifer was not encountered above the bedrock surface east of the pond. Bedrock here rises rapidly from less than 595 ft in GM-1 to 668 ft in GM-3.

Figure 7 is a water-level contour map of the alluvial aquifer as determined from water levels in the deep boreholes (GM-1, GM-2, and GM-6). Ground-water movement is toward the Ohio River. It was found that the water level in well GM-1 (615 ft) is lower than the level of the Ohio River (623 ft). Ground-water pumpage from wells at the PPG plant site is believed to be the cause of lowering the potentiometric level below the river level.

Vertical hydraulic conductivity of the clay and saturated silt beneath the mercury pond was determined in the laboratory. Water movement is extremely slow in the clays



EXPLANATION

680 —— Contour line showing bottom of perched-water zone, in feet, msl

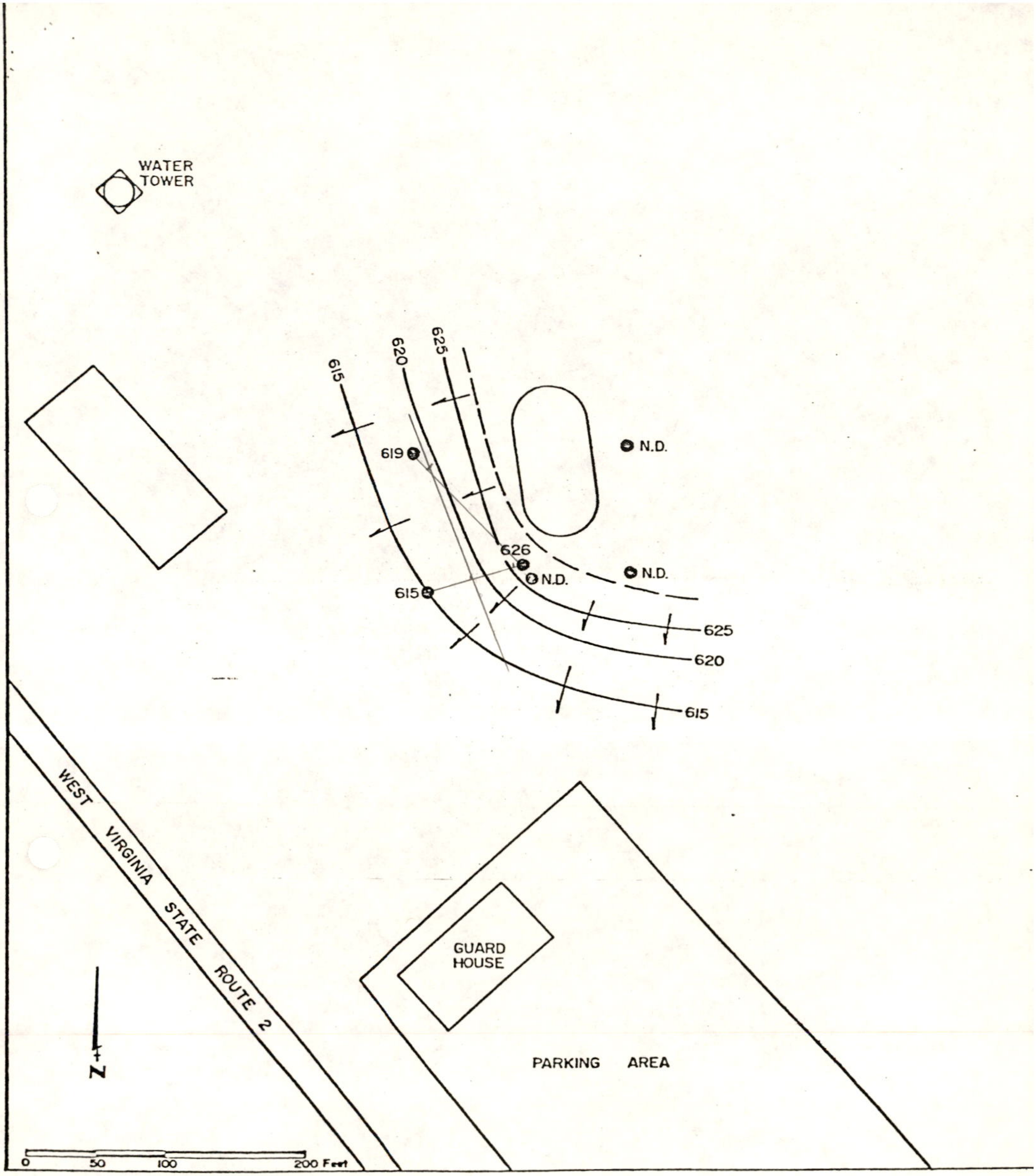
—— Inferred direction of ground-water flow

● Monitoring point

675 Elevation of perched-water zone, in feet, msl

Figure 6. Elevation of the Bottom of the Perched-Water Zone, PPG, Natrium, West Virginia.

Based on observation during drilling program and represents bottom of [illegible] zone



EXPLANATION

620 ——	Water-level contour, in feet, msl	●	Monitor well
— — —	Approximate boundary of surfical aquifer	626	Water-level elevation, in feet, msl
←	Direction of ground-water flow	N.D.	Not detected

Figure 7. Water-level Contour Map of the Ohio River Alluvial Aquifer, PPG, Natrium, West Virginia.

(3.0×10^{-8} cm/sec) and slow in the silts (1.5×10^{-6} cm/sec) (Table 3). The horizontal hydraulic conductivities could not be determined, but in sediments of this type they are typically about one order of magnitude greater. Several samples collected from GM-2 and GM-7 were tested to determine cation-exchange capacities of the sediments. The analyses are presented in Table 4 and exhibit relatively low exchange capacities, 10.39 meq/100 gm and less.

Ground-Water Quality

Water samples were collected from both the perched-water zone and the Ohio River alluvial aquifer to determine natural quality conditions and the present and/or past quality effects of the mercury pond. The results of the water-quality analyses are presented in Tables 5 and 6. Table 5 contains the analyses of samples collected from wells GM-1, GM-2, and GM-6; a PPG water-supply well located northwest of the mercury pond; and overflow from the mercury pond. Table 6 presents the results of leach tests run on the soil samples collected from perched-water zone and of two seeps along the face of the terrace.

This series of water-quality samples was directed primarily at inorganic water-quality parameters, including major cations and anions and selected trace elements included in the EPA drinking water standards. It was decided to

TABLE 3. VERTICAL HYDRAULIC CONDUCTIVITIES OF SHELBY TUBE SAMPLES

Well Number	Depth Interval (ft)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (ft/day)	Sample Description
*GM-2	11-13	3.0×10^{-8}	8.5×10^{-5}	Clay, tight, plastic, brown and orange-tan, with weathered rock fragments, micaceous
GM-3	27-29	1.5×10^{-6}	4.2×10^{-3}	Silt, clayey, gray-green with brown mottles, wet

*sieve analyses also available for this sample

TABLE 4. CATION EXCHANGE CAPACITIES OF SELECTED LITHOLOGIC SAMPLES

Well Number	Depth Interval (ft)	Cation Exchange Capacity (meq/100 gm)	Sample Description
GM-2	13 - 14.5	5.04	Clay, tight, plastic, brown and orange tan; with weathered rock fragments
GM-2	59.5 - 61	9.62	Clay, tight, plastic, red-brown; with weathered sandstone rock fragments
GM-2	99.5 - 101	10.39	Clay, brown, wet with rock fragments; mud-stone bedrock in lower half of sample
GM-7	29.5 - 31	0.0	Sand, fine grained, silty, clean, dry, orange brown to tan
GM-7	46 - 47.5	4.74	Clay, soft, moist, red-brown; with weathered sandstone fragments

TABLE 5: WATER QUALITY ANALYSES

(All analyses for par[illegible]s below are expressed in mg/l, except color an[illegible] which are expressed in standard units)

PARAMETERS	Sampling Points					Maximum Contaminants Levels *
	GM-1	GM-2	GM-6	Pond Overflow To Carbon Bed	PPG Plant Well	
Field Temp (°C)	14	14.5	14	-	-	
Field Specific Conductance (mhos/cm)	850	1,300	550	-	-	
Field pH	7.1	7.4	6.8	-	-	6.5 - 8.5
Total Dissolved Solids	532	1,117	338	32,200	340	500
Laboratory pH	7.9	7.5	7.9	11	7.2	6.5 - 8.5
Color (APHA)	15	10	5	0	0	15
Sodium	128	168	51.9	8,764	8.9	
Calcium	83.9	140	84.7	16.2	111	
Magnesium	28.5	24.2	10.6	1.1	10.4	
Manganese	0.12	2.3	0.012	<0.01	<0.005	0.05
Total Iron	<0.1	<0.1	<0.1	0.057	<0.1	0.3
Potassium	2.5	14.6	2.6	5.3	2.5	
Chloride	54	307	39	19,000	27	250
Sulfate	21	133	81	319	78	250
Nitrate as N	0.11	0.1	0.11	-	3.35	10
Alkalinity as $CaCO_3$	564	319	235	306	196	
Alkalinity as HCO_3	688	389	287	373	239	
Total Organic Carbon	60	690	9.0	-	5.0	
Arsenic	0.015	<0.005	<0.005	<0.005	<0.005	0.05
Barium	0.84	0.43	0.10	0.032	0.073	1
Cadmium	<0.005	<0.005	<0.005	<0.01	<0.005	0.01
Chromium (Total)	<0.1	<0.1	<0.1	<0.01	<0.1	0.05
Chromium (VI)	<0.01	<0.01	<0.01	<0.01	<0.01	
Copper	<0.1	<0.1	<0.1	<0.01	<0.1	1
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	0.05
Mercury	<0.0005	<0.0005	<0.0005	<0.019	<0.0005	0.002
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	0.01
Silver	<0.005	<0.005	<0.005	<0.01	<0.005	0.05
Zinc	<0.1	<0.1	<0.1	0.01	<0.1	
Fluoride	1.5	0.6	0.6	-	0.5	1.4 - 2.4

- No analysis made

* EPA Interim Primary or Secondary Drinking Water Standards

TABLE 6. SOIL LEACHATE AND WATER QUALITY ANALYSES

(All analyses for the parameters below are expressed in mg/l, except color and pH, which are expressed in standard units.)

PARAMETER	Soil Leachate				Spring	
	GM-7 (5-7 ft)		GM-7 (7-9 ft)		A	B
	1	2	1	2		
Total Dissolved Solids	2673	478	5043	1538	-	2040
pH	7.1	7.3	6.6	6.5	8.1	-
Color	15	83	0	0	-	-
Sodium	1050	219	1740	604	-	-
Calcium	11.0	9.8	29.7	11.4	-	-
Magnesium	<0.005	<0.005	8.4	0.5	-	-
Manganese	0.14	0.043	2.3	0.26	-	-
Total Iron	0.20	0.37	0.017	0.08	-	-
Potassium	1.8	1.8	3.0	1.6	-	-
Chloride	1535	328	2566	969	18176	669
Sulfate	71	47	67	44	390	275
Nitrate as N	0.3	1.0	0.4	0.3	-	-
Alkalinity as $CaCO_3$	59	49	21	33	-	-
Alkalinity as HCO_3	72	60	26	40	-	-
Total Organic Carbon	11.6	17.0	5.0	4.9	-	-
Arsenic	<0.005	<0.005	<0.005	<0.005	-	-
Barium	0.12	0.25	0.48	0.37	-	-
Cadmium	<0.02	<0.02	<0.02	<0.02	-	-
Chromium (Total)	<0.008	<0.008	<0.008	<0.008	-	-
Chromium (VI)	<0.01	<0.01	<0.01	<0.01	-	-
Copper	0.01	0.023	0.009	0.009	-	-
Lead	<0.005	<0.005	<0.005	<0.005	-	-
Mercury	<0.005	<0.005	<0.005	<0.005	<0.0002	<0.0002
Selenium	<0.005	<0.005	<0.005	<0.005	-	-
Silver	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	0.25	0.15	0.31	0.046	-	-

- No analysis made

evaluate only inorganic parameters at this time because the major contaminants of concern from both the old brine operation and present mercury process are inorganic in nature.

Ohio River Alluvial Aquifer

The monitoring network installed at the mercury pond is designed to permit evaluation of the effect of the pond on ground-water quality by comparing water samples both hydraulically above and below the pond. Well GM-3 was located at a point presumed to be hydraulically upgradient and wells GM-1, GM-2, GM-6, and boring GM-4 were located hydraulically downgradient. Because of an abrupt change in elevation of the bedrock beneath the pond, however, the upgradient well (GM-3) did not intercept a water table in the alluvium. Additionally, the water table was not found in the alluvium at GM-4 and is very thin at GM-6. The Ohio River alluvial aquifer could only be sampled at locations GM-1 and GM-2. Fortunately, both of the wells are downgradient from the pond, permitting a comparison with other ground water in the aquifer away from the pond area (the PPG plant well).

The quality of water in GM-1 and the PPG plant well are very similar in quality for all parameters tested. There is no apparent elevation of mercury or any other trace metals in GM-1 and in general these levels are below detection limits.

Except for a slightly elevated total dissolved solids level, the water at GM-1 is well within acceptable health standards.

The quality in GM-2 is elevated above both GM-1 and the PPG plant well. Potassium, chloride, TDS, and TOC are all significantly higher. Mercury and all other trace elements are below detection limits as was found in GM-1 and the PPG well. At this time, these conditions should not be construed to indicate contamination resulting from the brine pond or mercury pond. During drilling of this well, drilling water was used to stabilize the borehole. It is possible that this water was not completely removed before the well was sampled. Subsequent sampling is planned to investigate this possibility.

Perched-Water Zone

Monitor wells were installed into the perched-water zone at GM-3, GM-5, and GM-7; during the fall of 1980, only well GM-5 produced sufficient water for sampling purposes. In order to assess the quality of soil water in this zone, soil samples were collected from GM-7 and subjected to a leach process using distilled water at 7.0 pH. Limited water-quality analyses were also made on two seeps along the terrace.

There is a visible indication that the perched-water zone is contaminated below the pond. Vegetation along the face of the terrace is stressed and during dry periods a white salt crust is observed on the soil. The results of the water-quality analyses support the conclusion of contamination in the perched-water zone. Except in well GM-5, TDS, sodium, chloride, and sulfate levels are high in the perched-water zone. Several thousand mg/l of both TDS and chloride are present; both levels are far lower than that found in the mercury pond, however. Trace elements, including mercury, are not elevated in the perched zone.

The contaminants found in the perched-water zone are present in high concentrations in both the brine originally stored in the pond and the mercury effluent now stored there. Because of the absence of mercury in the perched-water zone and because the mercury pond is lined, it is theorized that the most likely source of the contaminated water was the old brine storage, and that the residual salts found in this study were deposited in the soil over 20 years ago. In many soil systems, salts are transported through the soil in pulses during rainfall or other high recharge events. This phenomenon has been seen near abandoned oil field brine storage ponds in alluvium along a river in Ohio (Pettyjohn, 1978). The data from Ohio indicates that it may take a very lone time to flush this contamination from the ground-water system.

RECOMMENDED RCRA GROUND-WATER MONITORING PROGRAM

The final design of the ground-water monitoring program at the mercury pond, including the number and location of monitor wells, the frequency of sampling, and the constituents to be analyzed for, is influenced by state and federal requirements. In order to comply with these regulations, an understanding of the May 19, 1980, hazardous-waste regulations (RCRA) applicable to owners and operators of hazardous-waste facilities is necessary.

The ground-water monitoring requirements under Subpart F of RCRA are written such that an owner/operator of a facility may utilize one of three possible ground-water monitoring programs. The fundamental program applies to a facility which is not assumed or known to be contaminating ground water. In most cases, this system would be utilized at new facilities or facilities under construction.

The second program applies to a facility which is assumed or known to be contaminating ground water. This alternate program would be oriented toward defining the extent of contamination and monitoring its further migration. The third program applies to a facility where a justification can be provided for a lesser degree of monitoring because the owner/operator can demonstrate a low potential for migration of hazardous-waste constituents from the facility via the uppermost aquifer to water-supply wells or surface water.

Based on the data collected during this hydrogeologic investigation, the situation at the mercury pond does not appear to rigorously fit any of the three programs suggested in the EPA regulations. At this time, however, the second program seems least applicable. Discussed briefly below, therefore, is more information on the two types of programs which may be applied.

The fundamental ground-water monitoring program sets the deadlines and requirements applicable to the installation of a ground-water monitoring system and procedures to be followed in the event water-quality samples indicate that ground water is being degraded. By November 19, 1981, PPG will be required to install monitoring wells. Monitoring wells must be installed hydraulically upgradient from the limit of the waste-management area to yield ground-water samples that are representative of background water-quality conditions in the uppermost aquifer near the facility. In addition, monitoring wells must be installed hydraulically downgradient from the limit of the waste management area at locations and depths which ensure that any "wastes" that migrate from the waste management area to the uppermost aquifer are immediately detected.

In addition to installing the monitoring-well system, PPG is required to prepare a ground-water quality assessment plan outline. The outline represents (in a preliminary scheme) the procedures that will be followed to assess the extent to which wastes have entered ground water in the event results of water sampling indicate a statistically significant difference between present and background water quality.

Finally, PPG must develop and have on file a ground-water sampling and analysis plan. This plan must include procedures and techniques for sample collection, sample preservation and shipment, analytical procedures and chain of custody control.

For a period of one year after PPG has installed the monitoring wells, they must be sampled regularly to establish background water quality. Samples must be taken every three months and analyzed for: (1) parameters characterizing the suitability of the ground water as a drinking water supply including arsenic, barium, cadium, chromium (hexavalent), fluoride, lead, mercury, nitrate, selenium, silver, endrin, lindane, methoxychlor, toxaphene, 2,4-D, 2,4,5-TP silvex, radium, gross alpha, gross beta, turbidity, and coliform bacteria, (2) parameters establishing ground-water quality including chloride, iron, manganese, phenols, sodium, sulfate, and (3) parameters used as indicators of ground-water contamination including pH, specific conductance, total organic carbon, and total organic halogens. After the first year, all monitoring wells must be sampled and the samples analyzed with the following frequencies: (1) parameters used to establish ground-water quality are sampled and analyzed annually, and (2) parameters used as indicators of ground-water contamination are sampled and analyzed semi-annually.

PPG must compare the results of the indicator parameter analyses with the background levels computed during the first year of monitoring and determine, by use of the Student's t-test, if a significant difference exists (at the 0.01 confidence interval). In addition, water-level readings must be taken to determine if the hydraulic gradient in the area has changed.

An alternative monitoring scheme is available if PPG can demonstrate that the mercury pond has a low potential to cause migration of contaminants; a lesser degree of monitoring may be used. The modified system could consist of fewer monitoring wells, less frequent sampling, analysis of fewer chemical parameters, or all of the above. To be utilized, the demonstration of a low potential for migration of contaminants must be certified by a qualified geologist or geotechnical engineer and must be in writing and kept on file at the facility.

Guidance for determining which monitoring system is most applicable to PPG is not stated in the regulations, nor has it been provided in guidance documents of the U.S. EPA. Several policy decisions and technical problems are left unresolved making it extremely difficult to develop a monitoring plan that is assured of satisfying both the State of West Virginia and the U. S. EPA. In an effort to resolve this problem and to gain some perspective from the state and the EPA regarding interpretation of the ground-water monitoring requirements, both state and federal officials were contacted. State officials indicate that each case would be handled on an individual basis; the federal contact at EPA Region III, however, suggests a strict interpretation of federal regulations, with no deviations, for compliance with and acceptance of RCRA ground-water monitoring plans. Although a cooperative work agreement has been drawn up between West Virginia Department of Natural Resources and EPA Region III, the agreement has not been implemented and PPG will probably have to work with each group separately.

Based on all of the foregoing, it is recommended that PPG institute the fundamental ground-water monitoring previously outlined for the Ohio River alluvial aquifer only. The PPG well should be considered the background well for the alluvial aquifer and wells GM-1, GM-2, and GM-6 will be down-gradient monitoring points.

Table 7 summarizes the sample frequency for all the parameters that PPG must analyze. Samples should be collected by a trained PPG employee. The water-quality analyses may be made by PPG if their lab has been approved by EPA, but otherwise should be made by an independent laboratory.

Additionally, it is recommended that an abbreviated sampling program be undertaken for the perched-water zone. This monitoring is not necessary for RCRA compliance but will provide PPG with a better understanding of movement of the remant contamination from the old brine-storage pond. Table 8 summarizes the sampling program for the perched-water zone.

A detailed sampling and analysis plan should be prepared and a ground-water assessment plan outline should be developed. Both must be present at the PPG site when sampling begins.

Respectfully submitted,

William E. Thompson
Senior Scientist

TABLE 7. MINIMAL SAMPLE COLLECTION AND ANALYSIS TO BE PERFORMED FOR RCRA COMPLIANCE

A. First Year

PARAMETER	PPG Water-Supply Well	GM-1, GM-2, GM-6
pH	4 replicates each quarter	quarterly
Specific Conductance	4 replicates each quarter	quarterly
Total Organic Carbon	4 replicates each quarter	quarterly
Total Organic Halogen	4 replicates each quarter	quarterly
Chloride	quarterly	quarterly
Iron	quarterly	quarterly
Manganese	quarterly	quarterly
Phenols	quarterly	quarterly
Sodium	quarterly	quarterly
Sulfate	quarterly	quarterly
Arsenic	quarterly	quarterly
Barium	quarterly	quarterly
Cadmium	quarterly	quarterly
Fluoride	quarterly	quarterly
Lead	quarterly	quarterly
Mercury	quarterly	quarterly
Nitrate (N)	quarterly	quarterly
Selenium	quarterly	quarterly
Silver	quarterly	quarterly
Endrin	quarterly	quarterly
Lindane	quarterly	quarterly
Methoxychlor	quarterly	quarterly
Toxaphene	quarterly	quarterly
2, 4-D	quarterly	quarterly
2, 4, 5-TP Silvex	quarterly	quarterly
Radium	quarterly	quarterly
Gross Alpha	quarterly	quarterly
Gross Beta	quarterly	quarterly
Coliform Bacteria	quarterly	quarterly

B. Second Year

pH	4 replicates twice/yr.	4 replices twice/yr.
Specific Conductance	4 replicates twice/yr.	4 replices twice/yr.
Total Organic Carbon	4 replicates twice/yr.	4 replices twice/yr.
Total Organic Halogen	4 replicates twice/yr.	4 replices twice/yr.
Chloride	annually	annually
Iron	annually	annually
Manganese	annually	annually
Phenols	annually	annually
Sodium	annually	annually
Sulfate	annually	annually

TABLE 8. SUPPLEMENTAL SAMPLING AND ANALYSIS FOR THE PERCHED-WATER ZONE

A. First Year

PARAMETER	GM-3, GM-5, GM-7, Spring A, & Spring B
pH	quarterly
Specific Conductance	quarterly
Chloride	quarterly
Sodium	quarterly
Sulfate	quarterly
Mercury	quarterly

B. Second Year

pH	semi-annually
Specific Conductance	semi-annually
Chloride	semi-annually
Sodium	semi-annually
Sulfate	semi-annually
Mercury	semi-annually

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APPENDIX A:

LITHOLOGIC LOGS OF SOIL BORINGS

GM-1

Elevation - top of outer casing:693.10 ft, msl

Lithologic Description	Depth (ft)	Thickness (ft)
Sandy loam, red brown	0 - 2	2
Clay, cinders, coal, sandstone fragments, red brown, moist	2 - 13	11
Gravel, poorly sorted, clayey, red brown, very moist	13 - 18	5
Clay, gravelly, coal fragments, red brown	18 - 23	5
Sand, medium to coarse grained, well sorted, red brown, coal fragments	23 - 43	20
Clay, stiff, red brown to yellow brown, weathered green to gray sandstone fragments	43 - 68	25
Silt, clayey, gray to yellow brown, iron stains	68 - 73	5
Clay, massive, plastic, gray	73 - 83	10
Silt, sandy, gray green to brown, sandstone fragments	83 - 93	10
Sand, silty, fine-grained, subrounded yellow brown, brownish-green gravel	93 - 96	3

GM-2

Elevation - top of outer casing: 709.88 ft, msl

Lithologic Description	Depth (ft)	Thickness (ft)
Silt, loam, brown, gravel	0 - 3	3
Clay, silty, brown to yellow brown, sandstone fragments, moist 11-13	3 - 33	30
Sand, medium grained, white to orange brown, rock fragments 34-36	33 - 43	10
Silt, clayey, tan to gray, wet 41-43	43 - 48	5
Clay, plastic, silty, red brown, weathered sandstone and coal fragments	48 - 93	45
Clay, gray to brown, coal and sandstone fragments, sand and silt lenses, moist	93 - 100	7
Mudstone, weathered, friable, gray, dry	100 - 106	6

GM-3

Elevation - top of outer casing: 721.99 ft, msl

Lithologic Description	Depth (ft)	Thickness (ft)
Clay loam, rock fragments, brown, micaceous, moist	0 - 3	3
Clay, plastic, stiff, rock fragments, brown, moist	3 - 23	20
Silt, clayey, gray-green, mottled, wet B-3 27-29' 30.5-32	23 - 33	10
Clay, stiff, red brown, sandstone fragments	33 - 50	17
Sandstone, friable, yellow brown to gray green, micaceous	50 - 55	5

GM-4

Elevation - land surface: 715 ft, msl

Lithologic Description	Depth (ft)	Thickness (ft)
Cinders	0 - 5	5
Sand, silty, medium grained, tan to brown, micaceous, plastic clay lenses	5 - 6.5	1.5
Clay, stiff, red brown, yellow mottling, sandstone and coal fragments, moist	6.5 - 29	22.5
Sand, silty, brown to orange, lenses of plastic clay, sandstone fragments	29 - 33.5	4.5
Silt, sandy, brown, rock fragments, moist	33.5 - 38	4.5
Sand, fine to coarse grained, poorly sorted, brown to tan, wet	38 - 41.5	3.5
Silt, clayey, gray, sandstone fragments, moist B4 41.5-43	41.5 - 48	6.5
Clay, silty, green to gray, sandstone fragments, micaceous	48 - 79	29
Mudstone, friable, gray to brown, dry	79 - 81	2

GM-5

Elevation - top of outer casing: 718.39 ft, msl

Lithologic Description	Depth (ft)	Thickness (ft)
Same as GM-4	0 - 50	

GM-6

Elevation - top of outer casing: 696.90 ft, msl

Lithologic Description	Depth (ft)	Thickness (ft)
Clay loam, orange brown, gravel, moist	0 - 3	3
Clay, dense, brown, gravelly	3 - 18	15
Sand, silty, medium to coarse grained, poorly sorted, brown, moist, sandstone fragments	18 - 41	23
Clay, dense, red brown, sandstone fragments	41 - 60	19
Silt, clayey, green, wet	61 - 64	3
Clay, stiff, red brown, sandstone fragments	64 - 75	11
Siltstone, friable, gray, micaceous, shaley	75 - 80	5

GM-7

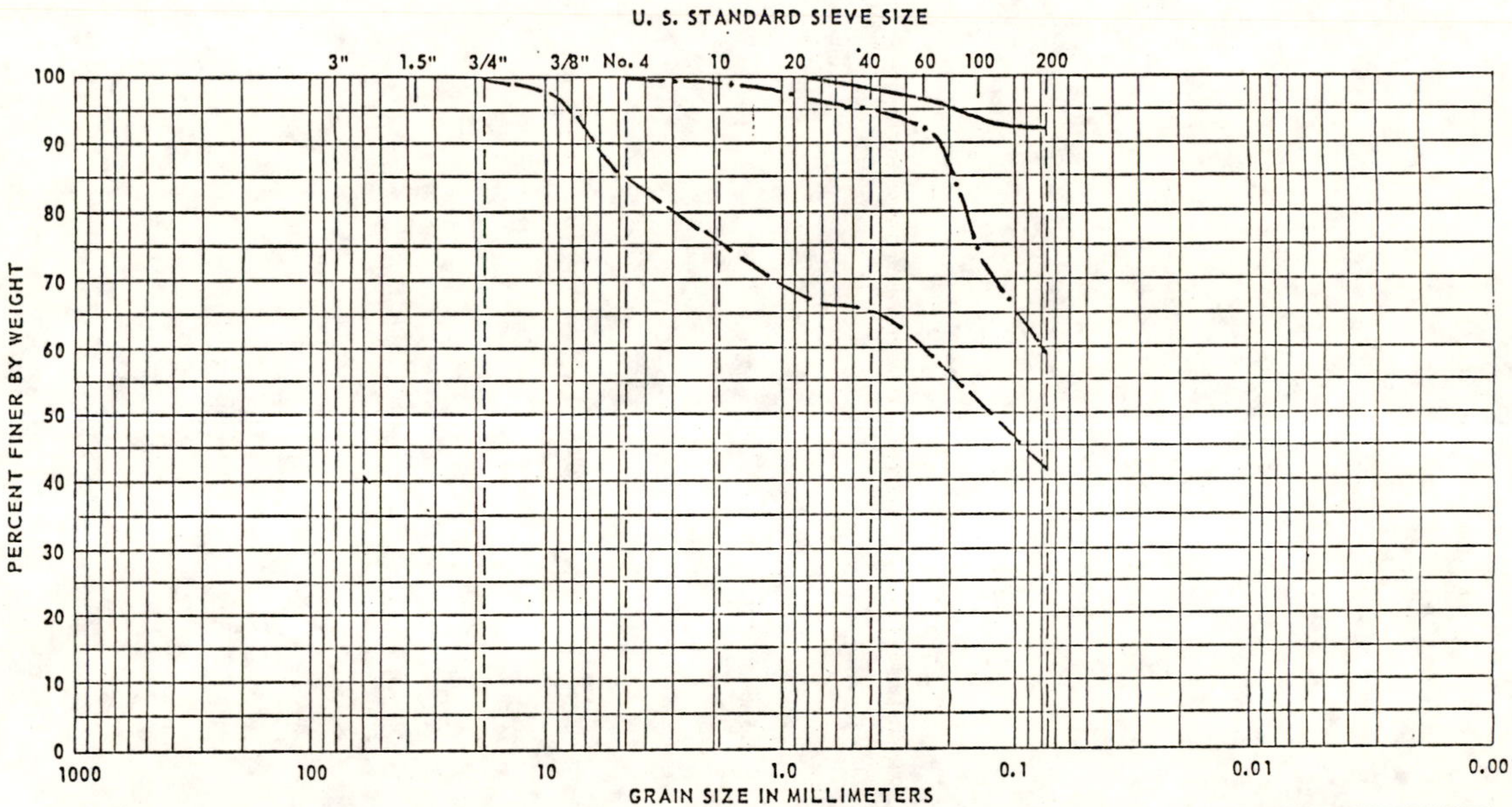
Elevation - top of outer casing: 710.74 ft. msl

Lithologic Description	Depth (ft)	Thickness (ft)
Same as GM-2	0 - 29.5	29.5
Sand, silty, fine grained, orange brown to tan, rock fragments	29.5 - 43	13.5
Clay, plastic, red brown, sandstone fragments, moist	43 - 56	13

APPENDIX B:

RESULTS OF SIEVE ANALYSES ON SELECTED SOIL SAMPLES

GRAIN SIZE DISTRIBUTION CURVE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	BORING	DEPTH	LINE	CLASSIFICATION	NAT. WC	LL	PL	PI	REMARKS	PLOTTED BY:
TUBE	B-3	27.0-29.0	——	DULL GRN SILTY CLAY TRACE SAND	27%				FINE SANDS	NR
S-20	B-3	30.5-32.0	— —	LT GRN-BRN CLAYEY SILT AND SAND LITTLE GRA[illegible]	14%				FINE GRAVEL SUB/ [illegible]	NR
S-26	B-4	41.5-43.0	—·—	DULL GRN SANDY SILT	22%				TRACE CLAY	NR
			—··—							

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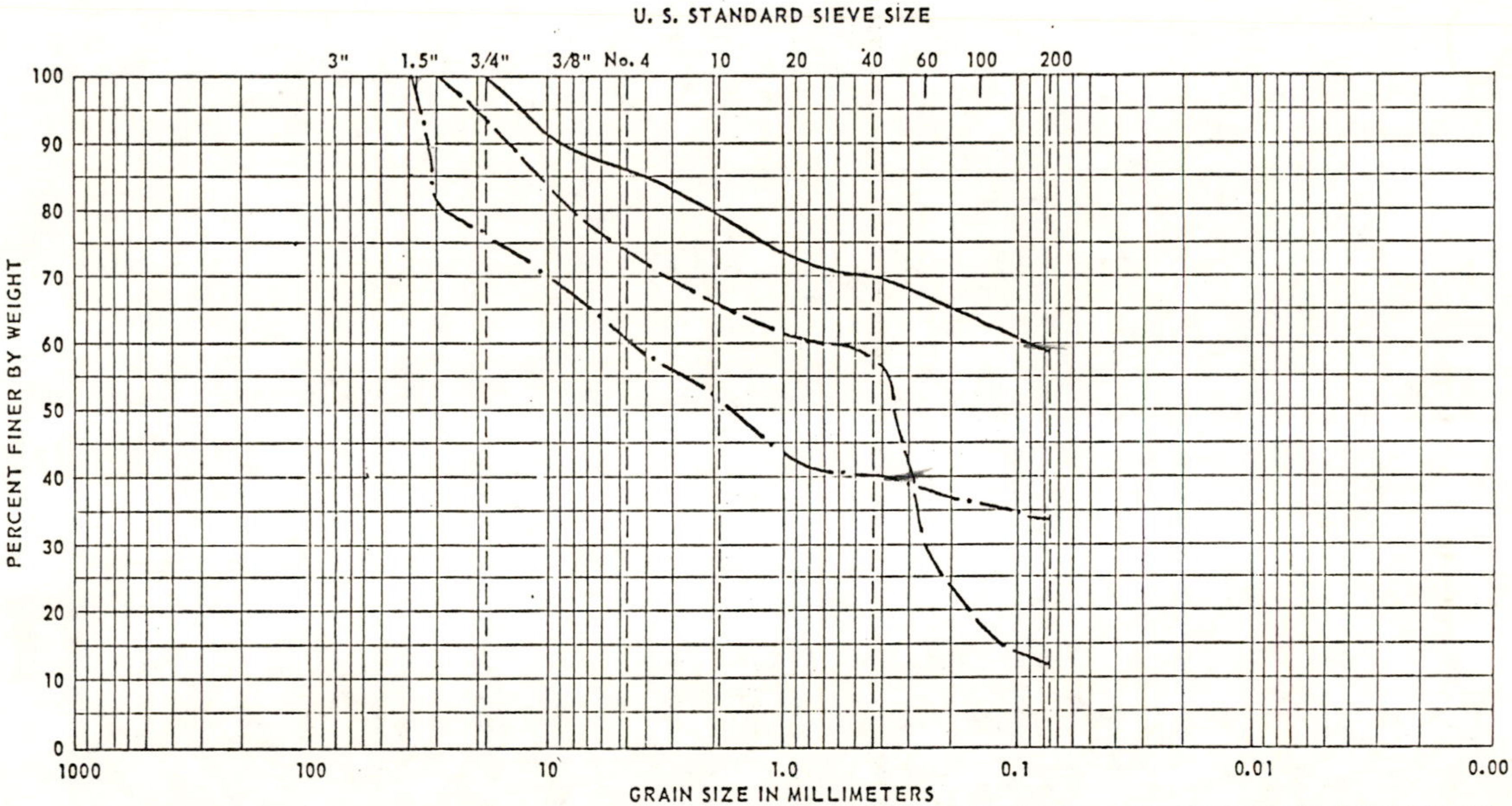
GRAIN SIZE DISTRIBUTION CURVE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	BORING	DEPTH	LINE		CLASSIFICATION	NAT. WC	LL	PL	PI	REMARKS	PLOTTED BY:
TUBE	B-2	11.0'-13.0'	——		DK BRN MED STIFF CLAYEY SILT SOME SAND LITTLE GRAVEL	14%				LITTLE F, M, C SANDS } SUB FEW F, M GRAVELS } ANGULAR	NR
S-10	B-2	34.5'-36.0'	— —		TAN BRN LOOSE SILTY SAND, SOME GRAVEL	7%				LITTLE FINES SOME F, M, GRAVELS - SUBANGULAR	NR
S-24	B-2	104'-105.5'	—·—		GRAY MED STIFF SILTY CLAY AND GRAVEL SOME SAND	7%				WELL GRADED SUBANGULAR SANDS AND GRAVELS	NR
			—··—								

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PITTSBURGH TESTING LABORATORY

ORDER NO. BLT 317

B-3

FORM NO. 1435